

BEST AVAILABLE COPY

Appendix

12. A method of constructing a golf club for a golfer, comprising steps of:
 - determining a design loft of the club;
 - determining a length, lie, and offset of the club;
 - determining a swing characteristic of the golfer;
 - using the swing characteristic, at least in part, to determine a lean angle such that the effective loft for the golfer has a predetermined relationship to the design loft; and
 - constructing a club having the determined design loft and lean angle, the club being a wood, an iron, or a wedge;
 - wherein the lean angle is determined, at least in part, by at least one of the length, lie, and offset of the club;
 - wherein determining the lean angle and constructing the club are repeated for a plurality of golf clubs;
 - wherein determining the lean angle includes a step of correlating across the plurality of clubs a swing characteristic selected from the group consisting of:
 - a location of the hands of the golfer upon impact of a club with a golf ball;
 - an effective loft of a club for the golfer;
 - a relative difference between design loft and effective loft of a club for the golfer;
 - a location of the golf ball in the stance of the golfer when the golfer addresses a golf ball;
 - a location of the hands of the golfer when the golfer addresses a golf ball; and
 - a location of the hands of the golfer with respect to a location of a golf ball in the stance of the golfer when the golfer addresses a golf ball; and
 - wherein the correlating step includes locating the golf ball progressively backward in the golfer's stance, away from the target, for increasingly longer clubs in the plurality of clubs.
29. A method of constructing a designed golf club having a lean angle, design loft, length, lie, and offset, which lean angle is non-zero, the method comprising steps of:
 - selecting a desired effective loft to be achieved when the designed golf club is swung by a particular golfer;
 - determining an achieved effective loft when the particular golfer swings a test golf club having a lean angle, design loft, length, lie, and offset;
 - based on the determined achieved effective loft with the test golf club, selecting a relationship between or among lean angle, design loft, length, lie, and offset for the designed golf club so that, when the golfer swings the designed golf club as the test golf club was swung, the desired effective loft is achieved;
 - choosing a non-zero lean angle for the designed golf club having the selected relationship to design loft, length, lie, and offset; and
 - after the relationship is selected and non-zero lean angle is chosen, constructing the designed golf club having the chosen non-zero lean angle and achieving the desired

effective loft when swung by the particular golfer.

30. The method as defined in claim 29, the method further comprising a step of selecting a desired design loft, length, lie, and offset for the designed golf club.
31. The method as defined in claim 29 wherein the designed golf club and test golf club have substantially the same design loft, length, lie, and offset .
32. The method as defined in claim 29 wherein the test golf club has a zero lean angle.
33. The method as defined in claim 29 wherein the step of determining the achieved effective loft when the particular golfer swings the test golf club is performed by using an automated observing system.
34. The method as defined in claim 33 wherein the automated observing system includes an image forming device coupled to an image display for observing the particular golfer swinging the test golf club.
35. The method as defined in claim 34 wherein the automated observing system includes a slow-motion capability to analyze the achieved effective loft when the particular golfer swings the test golf club.
36. The method as defined in claim 33 wherein the step of determining the achieved effective loft when the particular golfer swings the test club includes determining the achieved effective loft based upon a trajectory of a golf ball struck by the test golf club.
37. The method as defined in claim 29 wherein the steps of:
 - selecting a desired effective loft to be achieved when the designed golf club is swung by a particular golfer;
 - determining an achieved effective loft when the particular golfer swings a test golf club having a lean angle, design loft, length, lie, and offset;
 - based on the determined achieved effective loft with the test golf club, selecting a relationship between or among lean angle, design loft, length, lie, and offset for the designed golf club so that, when the golfer swings the designed golf club as the test golf club was swung, the desired effective loft is achieved;
 - choosing a non-zero lean angle for the designed golf club having the selected relationship to design loft, length, lie, and offset; and
 - after the relationship is selected and non-zero lean angle is chosen, constructing the designed golf club having the chosen non-zero lean angle and achieving the desired effective loft when swung by the particular golfer are repeated for a plurality of clubs.
38. The method as defined in claim 37, the method further comprising a step of correlating across the plurality of clubs a swing characteristic selected from the group consisting of:

- a location of the hands of the golfer upon impact of a club with a golf ball;
 - an effective loft of a club for the golfer;
 - a relative difference between design loft and effective loft of a club for the golfer;
 - a location of the golf ball in the stance of the golfer when the golfer addresses a golf ball;
 - a location of the hands of the golfer when the golfer addresses a golf ball; and
 - a location of the hands of the golfer with respect to a location of a golf ball in the stance of the golfer when the golfer addresses a golf ball.
39. The method as defined in claim 38 wherein the correlating step includes locating the golf ball progressively forward in the golfer's stance, towards the target, for increasingly longer clubs in the plurality of clubs.
 40. The method as defined in claim 38 wherein the correlating step includes locating the golf ball progressively backward in the golfer's stance, away from the target, for increasingly longer clubs in the plurality of clubs.
 41. The method as defined in claim 38 wherein the correlating step includes substantially matching the particular swing characteristic for each club within the plurality of clubs.
 42. The method as defined in claim 41 wherein the swing characteristic to be matched is the relative difference between the design loft and the effective loft for each club within the plurality of clubs.
 43. The method as defined in claim 42 wherein the relative difference between the design loft and the effective loft for each club is intended to be approximately zero.
 44. A method of designing a golf club having a lean angle, design loft, length, lie, and offset, which lean angle is non-zero, the method comprising steps of:
 - selecting a desired effective loft to be achieved when the designed golf club is swung by a particular golfer;
 - determining an achieved effective loft when the particular golfer swings a test golf club having a lean angle, design loft, length, lie, and offset;
 - based on the determined achieved effective loft with the test golf club, selecting a relationship between or among lean angle, design loft, length, lie, and offset for the designed golf club so that, when the golfer swings the designed golf club as the test golf club was swung, the desired effective loft is achieved; and
 - choosing a non-zero lean angle for the designed golf club having the selected relationship to design loft, length, lie, and offset.
 45. The method as defined in claim 44 wherein the non-zero lean angle of the golf club is less than 15 degrees.

46. The method as defined in claim 45 wherein the non-zero lean angle of the golf club is greater than 3 and less than 10 degrees.
47. The method as defined in claim 29 wherein the non-zero lean angle of the golf club is less than 15 degrees.
48. The method as defined in claim 29 wherein the non-zero lean angle of the golf club is greater than 3 and less than 10 degrees.
49. The method as defined in claim 29 wherein the desired effective loft is approximately equal to the design loft.
50. A golf club comprising:
 - a head having a sole; and
 - a shaft connected to the head, the connection arranged so that the shaft forms a non-zero lean angle with the vertical when the head rests on its sole, the head having been cast or forged at the time of manufacture to achieve the non-zero lean angle.
51. A golf club comprising:
 - a head having a sole; and
 - a shaft connected to the head, the connection arranged so that the shaft forms a non-zero lean angle with the vertical when the head rests on its sole, the non-zero lean angle being greater than 3 degrees.
52. The golf club as defined in claim 51 wherein the lean angle is greater than 3 and less than 15 degrees.
53. The golf club as defined in claim 51 wherein the lean angle is greater than 3 and less than 10 degrees.
54. A golf club comprising:
 - a head having a sole; and
 - a shaft connected to the head, the connection arranged so that the shaft forms a non-zero lean angle with the vertical when the head rests on its sole, the center of mass of the golf club being in substantially the same location as at the time of manufacture.
55. A golf club comprising:
 - a head having a sole; and
 - a shaft connected to the head, the connection arranged so that the shaft forms a non-zero lean angle with the vertical when the head rests on its sole, the connection being substantially parallel to the shaft.
56. A method comprising steps of:

selecting a structure for a golf club head having a face, a sole, and a design loft;
selecting a structure for a hosel, so that, if the golf club head were attached to a shaft at the hosel and the sole of the golf club head were positioned on a flat surface so that its face achieves the design loft with respect to a plane perpendicular to the flat surface, the angle drawn between the centerline of the shaft and a plane perpendicular to the flat surface is non-zero; and
forging or casting the selected structure for the golf club head and hosel.

57. The method of claim 56, further comprising the step of attaching a shaft to the golf club head at the hosel.

58. A method of manufacturing a golf club, the method comprising steps of:

selecting a structure for a golf club head having a face and a sole so that, if the head were attached to a shaft and positioned on a flat surface with a 90° angle between the shaft and the flat surface, the head would have a predetermined design loft equal to that angle made by the face of the head and a line perpendicular to the flat surface; and

manufacturing a golf club whose head has the selected structure and is attached to the shaft so that, if the head were positioned on a flat surface so that its face achieves the predetermined design loft with respect to the perpendicular, the shaft would not be perpendicular to the flat surface.

59. In combination, a golf club head and a hosel, the golf club head having a face, a sole, and a design loft, the golf club head and hosel being arranged so that if the golf club head were attached to a shaft at the hosel and the sole of the golf club head were positioned on a flat surface so that its face achieves the design loft with respect to a plane perpendicular to the flat surface, the angle drawn between the centerline of the shaft and a plane perpendicular to the flat surface is non-zero.

60. A golf club comprising:

a golf club head having a face, a sole, and a design loft; and

a shaft connected to the head, the connection arranged so that if the head were positioned on a flat surface so that its face achieves the design loft with respect to the perpendicular, the shaft would not be perpendicular to the flat surface.